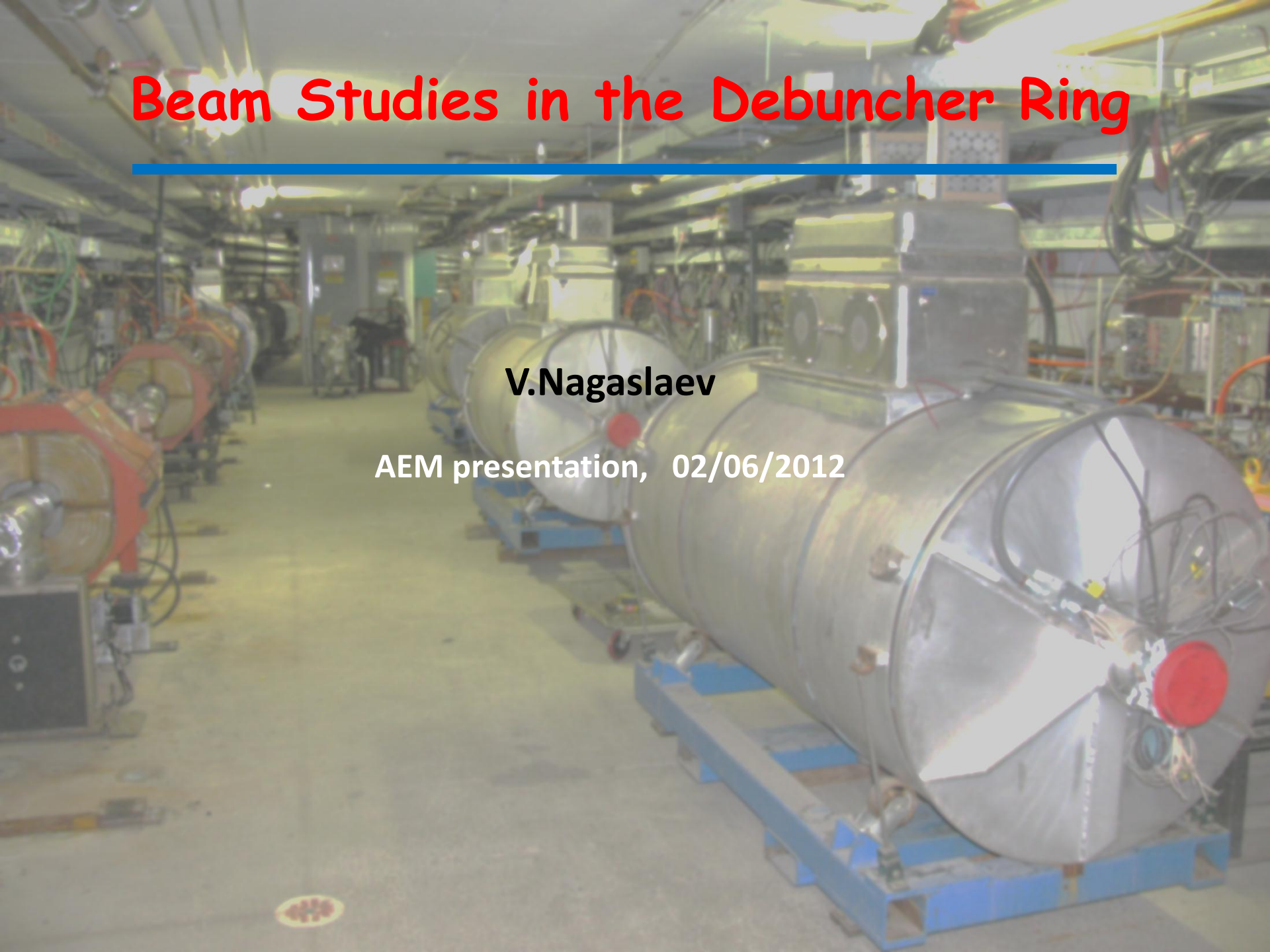


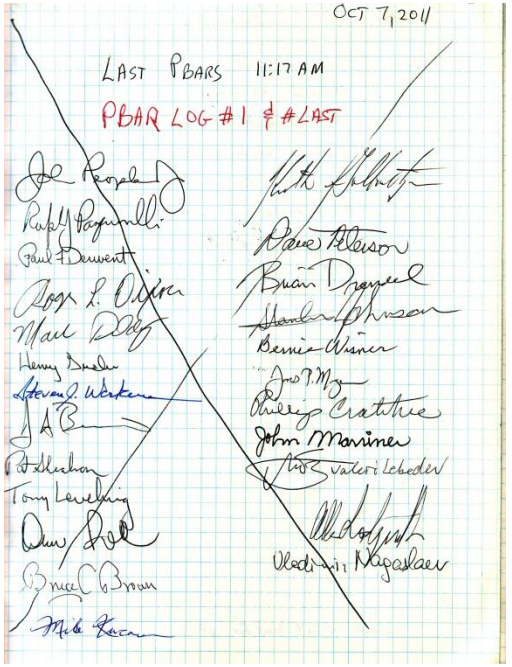
Beam Studies in the Debuncher Ring

V.Nagaslaev

AEM presentation, 02/06/2012

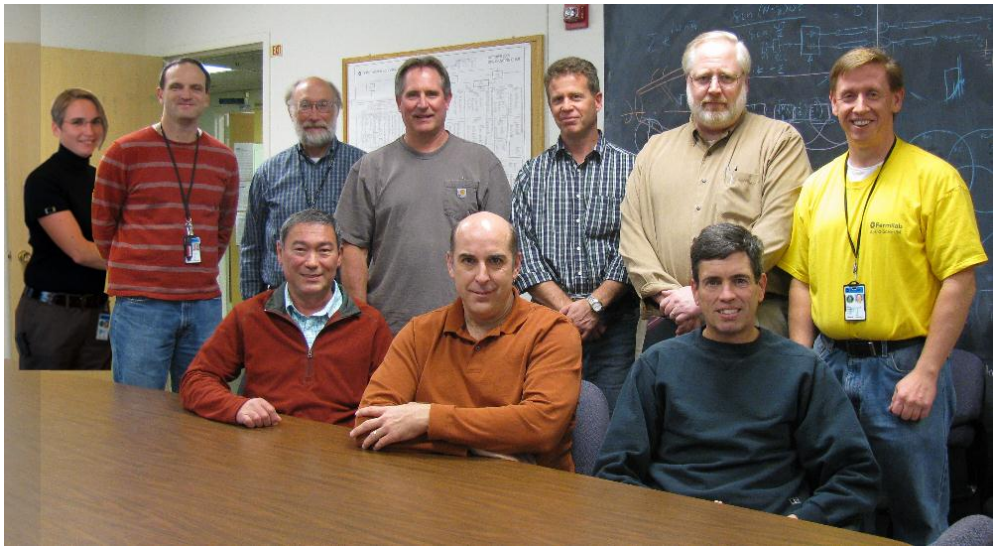
New faces of the Antiproton Source

- 09/30/2011: End of the Tevatron Collider program
- 10/07/2011: End of the Antiproton Program



Antiproton Source as a machine will become:

- Part of the Mu2e Project
- Part of the new g-2 Project
- There will be no way back



Antiproton Source (department)

↓

Muon Department

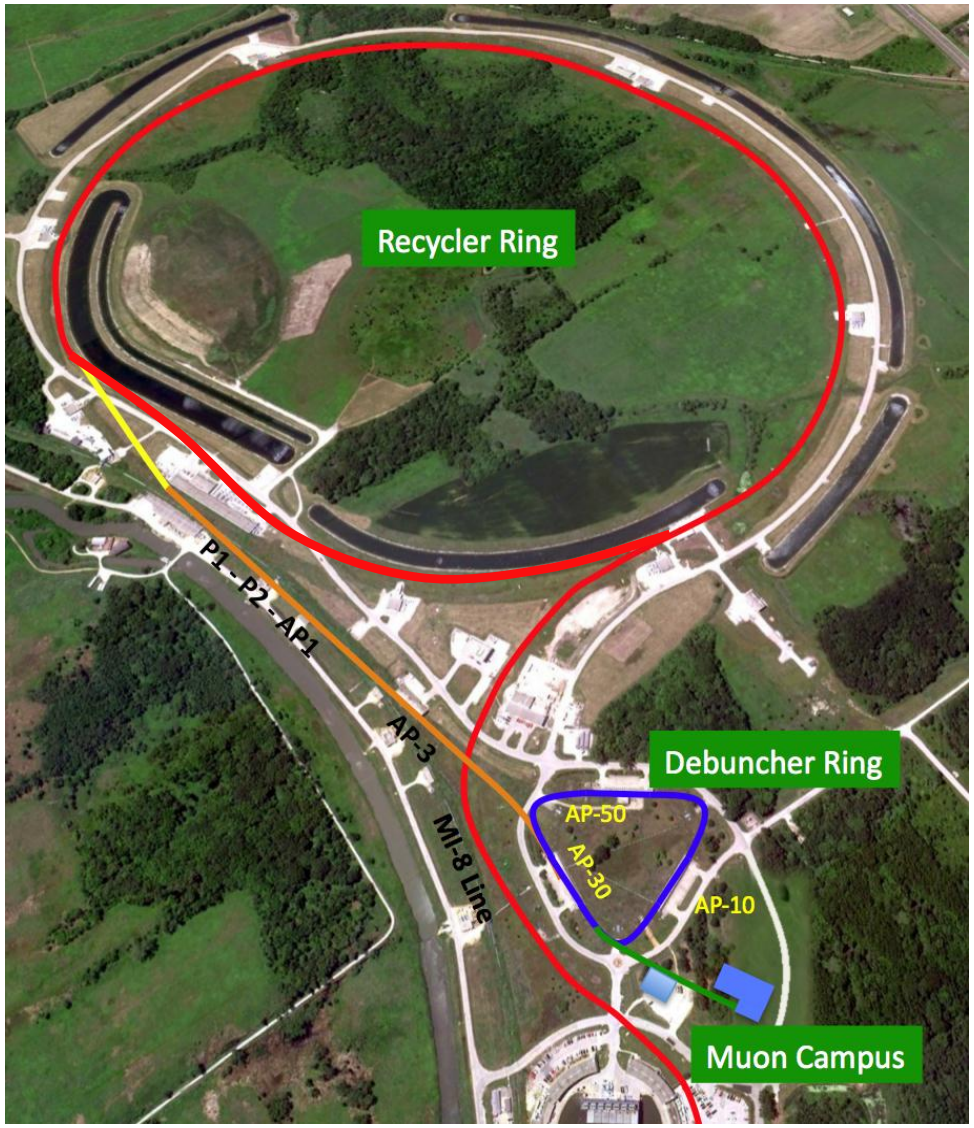
New goals of the Muon Source

Mu2e Project

- 8GeV proton beam Recycler → Debuncher
- Slow (resonant) extraction to the experiment

Resonant extraction:

- Used for a slow extraction
- New tool to control the spill rate: RFKO - "heating" the beam



New goals of the Muon Source

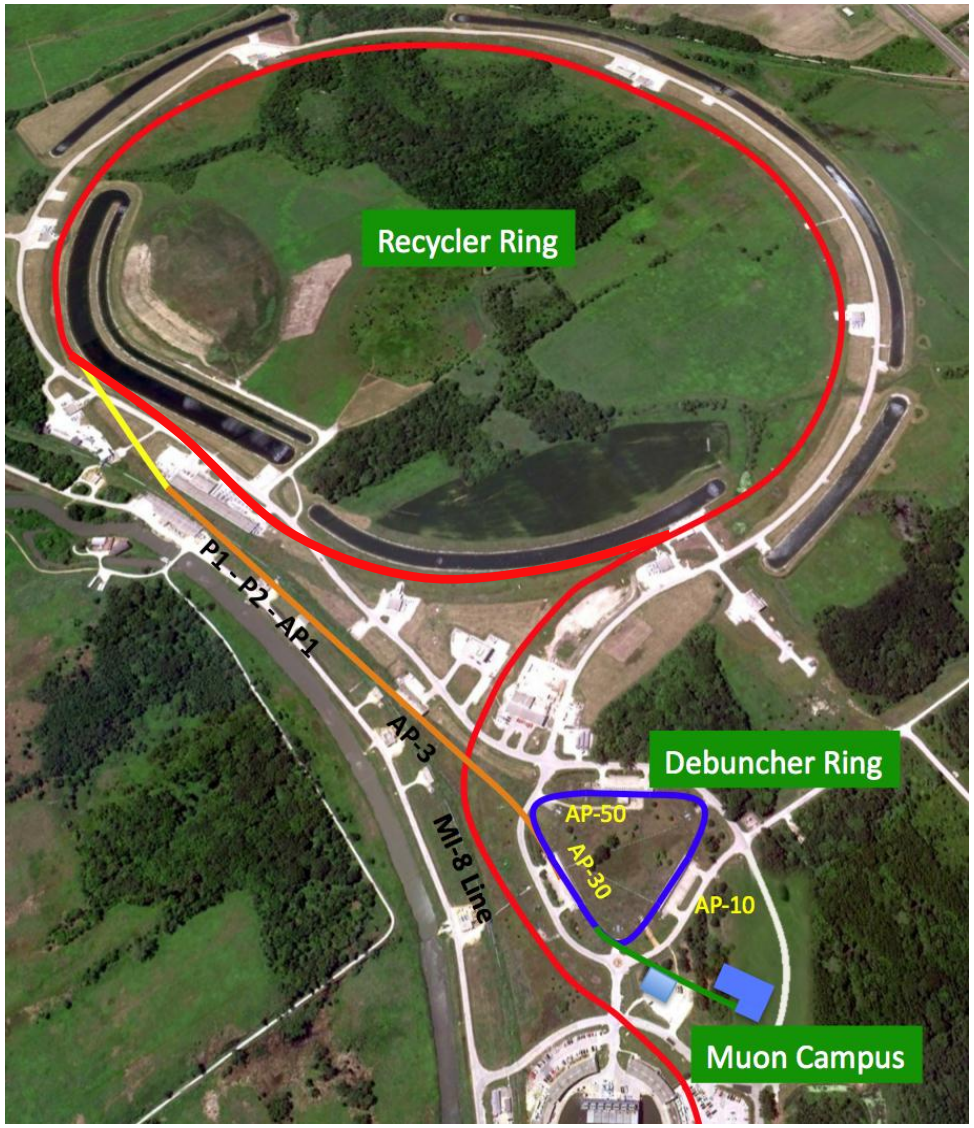
G-2 Project

- 8GeV proton beam Recycler → target
- Conversion to 3.1 GeV pions→muons
- Fast extraction to the experiment

Lots of synergy with Mu2e:

- RF bunch formation in RR
- Transport
- Debuncher manipulations
- Same extraction channel
- Common part of the new tunnel
- Common Cryo facility

Muon Campus



What is going in the Muon Source now

- Antiproton production not available with termination of CRYO operation
- Decommissioning will not start until new projects are ready to do it
- All beam lines and rings are perfectly capable to run the proton beam
- Proton studies in the Pbar are fully parasitic to NuMi and Switchyard
- Proton beam operations may become unavailable after the NOVA shutdown
- This is the perfect time for machines studies

- Studies to support Mu2e and G-2 programs
  - Radiation monitoring (TLM)
  - Beam line losses/aperture
  - Tune space in the Debuncher
  - RFKO in the Debuncher
  - Target yield tests (g-2)
- Misc work that does not require beam
- General purpose studies:
  - Also possible

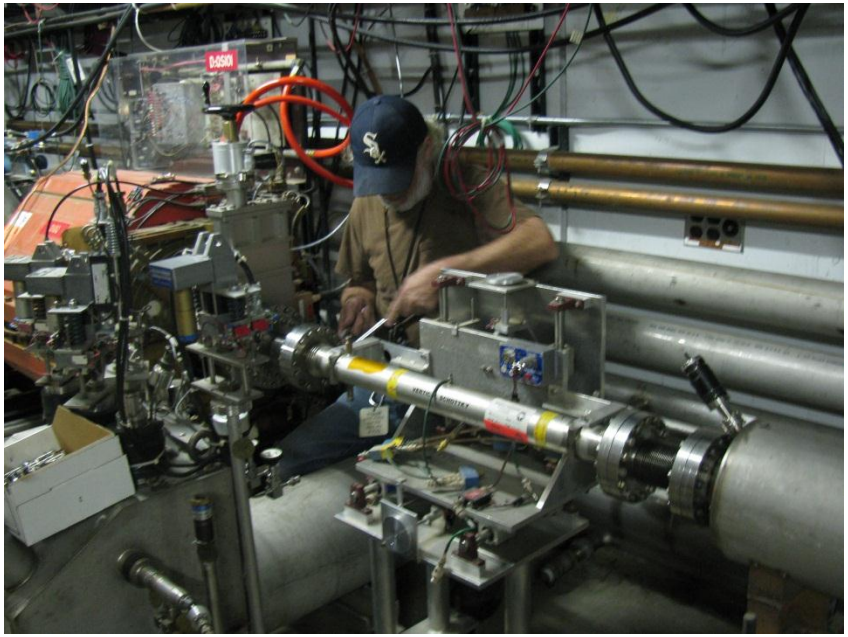
Technical issues with Proton beam in the Debuncher

- Limited diagnostics:
  - Schottky detectors (removed in 2006) ✓
  - No TBT diagnostics
  - IPM maintenance needed ✓
- Lifetime
  - Low vacuum
- Beam stability
  - High narrow-band impedance of the rotator cavities (6) – blows up the beam energy distribution ✓

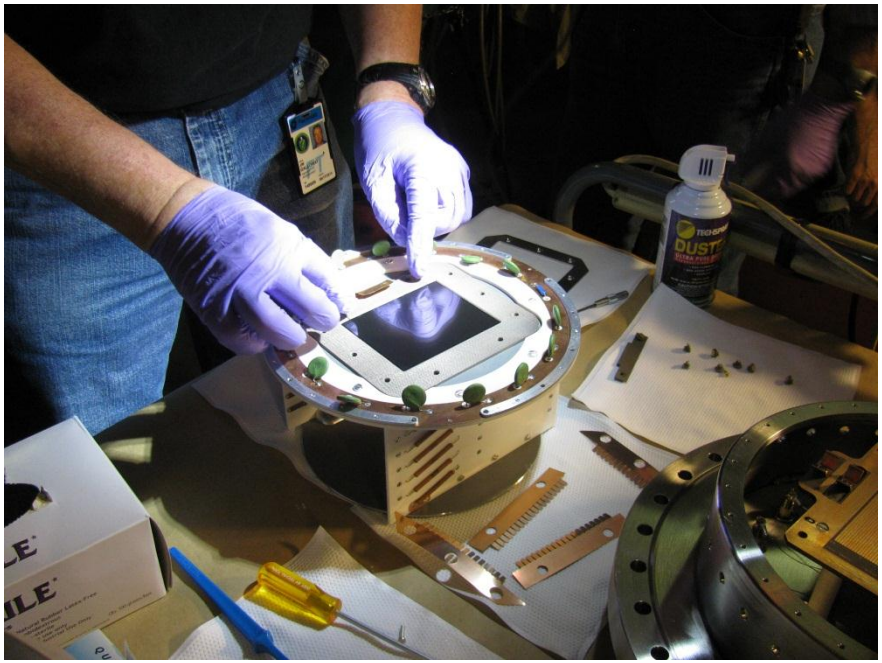
Rings preparations started shortly after the end of Run-II

Modifications to the Rings

Diagnostics



3 Schottky detectors
installed in the Debuncher



Replaced MCP plates
in existing Debuncher IPMs

Modifications to the Ring

An old style Tevatron damper kicker installed in the Debuncher as an RFKO element

Modifications to the Ring

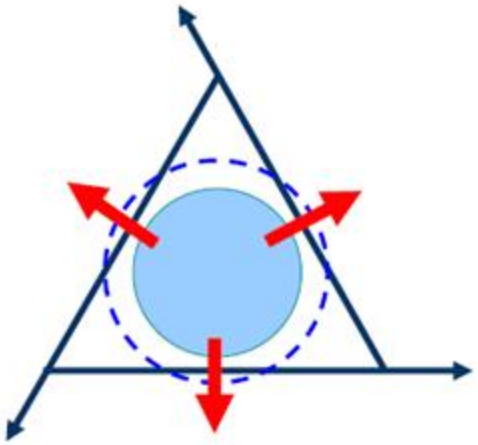
DRF1 cavities in the Debuncher-50

DRF1-(2-7) cavities removed

RF Knock out studies-1 (Mu2e)

- What is 3rd resonance
  - Making trajectories unstable in a controlled way
  - Good efficiency
  - Good control
- Control:
  - Quads field ramp
  - Sextupole field ramp
  - → Shrinking the separatrix
- Challenge:
  - Space Charge
  - Non-uniform tune spread

- Use RFKO to compensate
- What is the RFKO
  - Coherent excitation
  - Mixing→ incoherent heating
  - → pushing beam out
  - fast

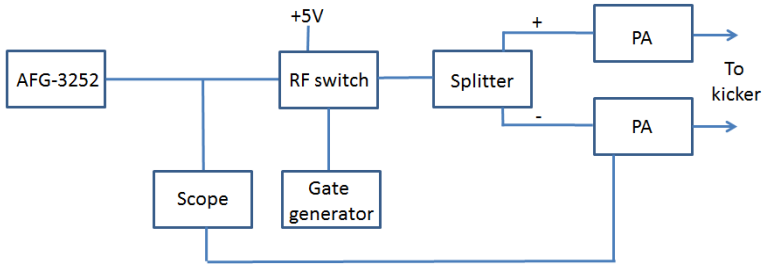


- 3rd integer extraction has never been used at Fermilab before
- RFKO has had limited use in the world until very recently

We need to test these techniques and benchmark our simulations as much and as early as we can

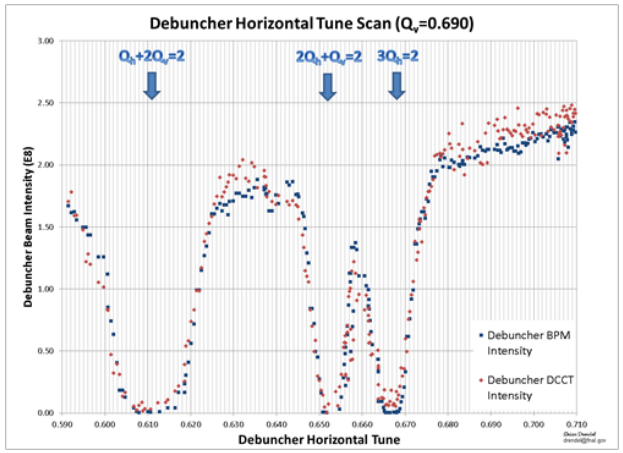
RF Knock out studies-2 (Mu2e)

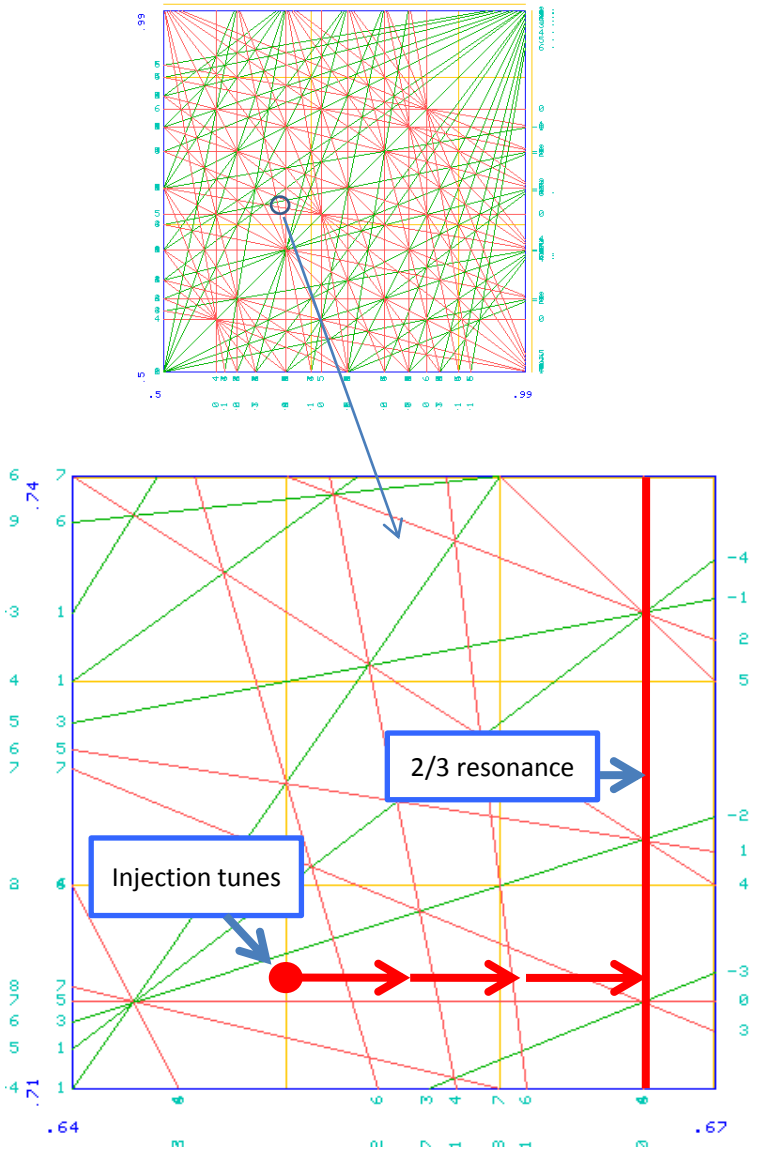
- Need good mixing → tune spread
- Heating has to cover this tune spread → FM is required
- To control power, RFKO has to be in the feedback loop with the spill monitor → AM modulation
- Low level: waveform generator AFG-3252
- High level: 2 0.5kW solid state PA from Amplifier Research
- RF switch triggered from T-Clock event
- 10Hz IPM scanner triggered with same clock event
- 5 sec scan time



Tune space studies (Mue2)

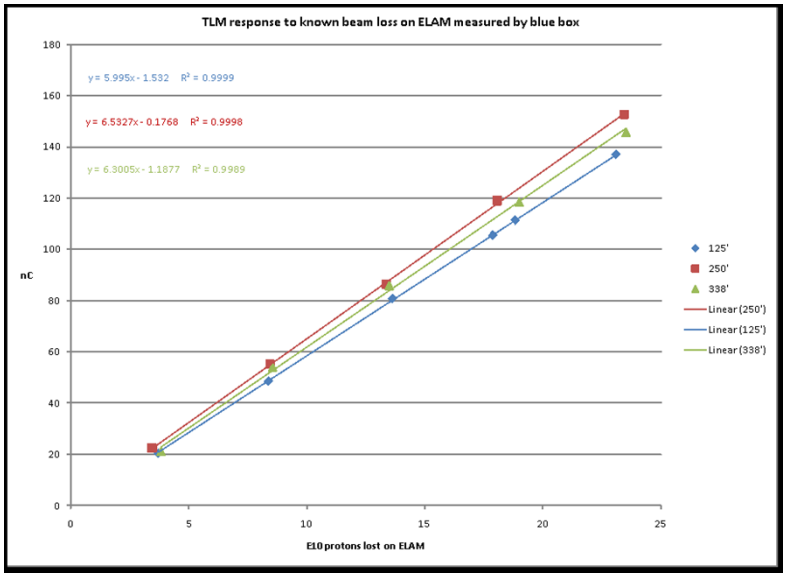
- Carefully select OP
- Can not avoid higher resonances on the tune ramp
- Strength of resonances depend on natural multipole components in magnets
- Already now we can see something about those strengths





TLM monitoring studies

- Motivation
  - Moving to Intensity Frontier
  - High demand for simple and robust radiation monitors
  - Safety device
- What is the TLM?
  - Simple
  - Cheap
  - Flexible
  - Long
  - Can it be a safety device?
- What can we do?
  - Create beam losses
  - Gauge TLM across rad mon
  - Determine dynamic range
  - Investigate operation conditions, reliability, …



Summary

- We have a time period when Pbar/Muon source is available for beam studies
- A number of beam studies is carried out. Some of them serve future projects (Mu2e and G-2), some have broader impact for the whole Lab
- A possibility for more studies still remains.